2018 Nitrogen Dioxide Summary

New Jersey Department of Environmental Protection

Sources

Nitrogen dioxide (NO_2) is a reddish-brown highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). NO_2 is used by regulatory agencies as the indicator for the group of gases known as nitrogen oxides (NO_x). These gases are emitted from motor vehicle exhaust, combustion of coal, oil or natural gas, and industrial processes such as welding, electroplating, and dynamite blasting. Although most NO_x is emitted as NO, it is readily converted to NO_2 in the atmosphere. In the home, gas stoves and heaters produce substantial amounts of nitrogen dioxide. When NO_2 reacts with other chemicals it can form ozone, particulate matter, and other pollutant compounds. A pie chart summarizing the major sources of NO_x in New Jersey in 2017 is shown in Figure 6-1.

Figure 6-1
2017 New Jersey NO_x Estimated Annual Emissions

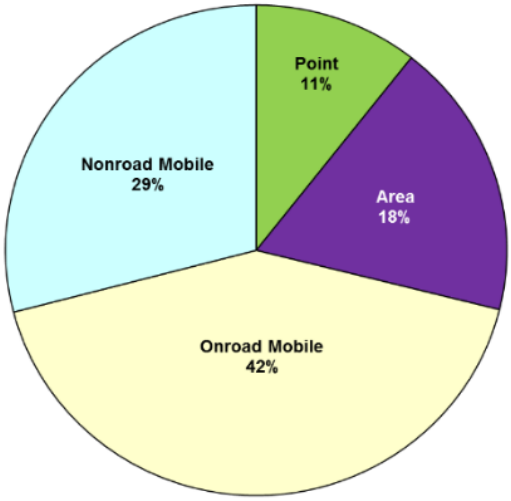
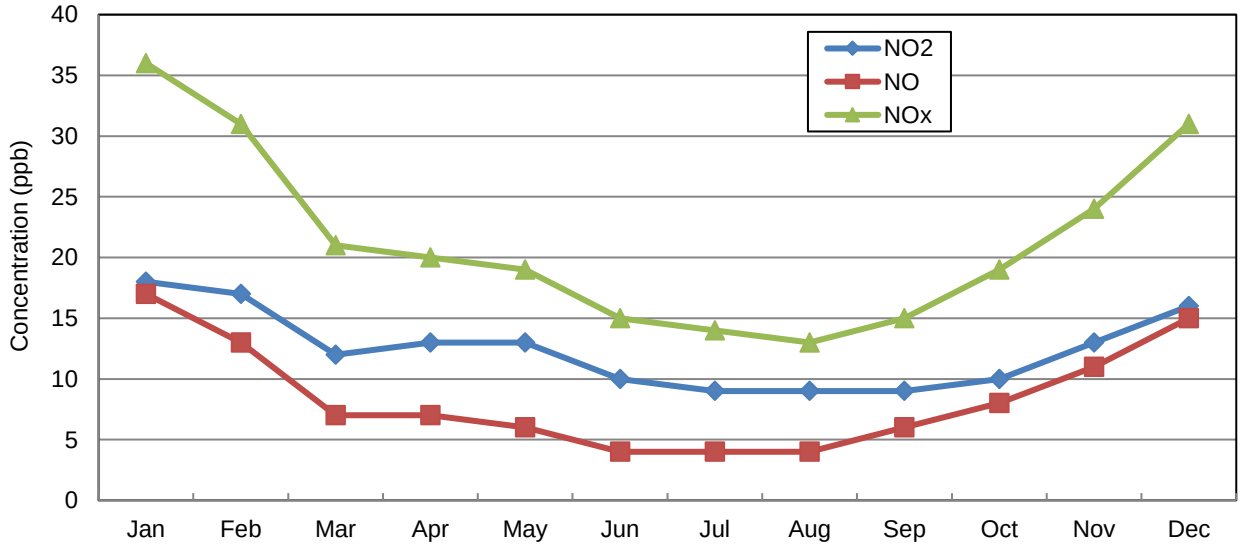


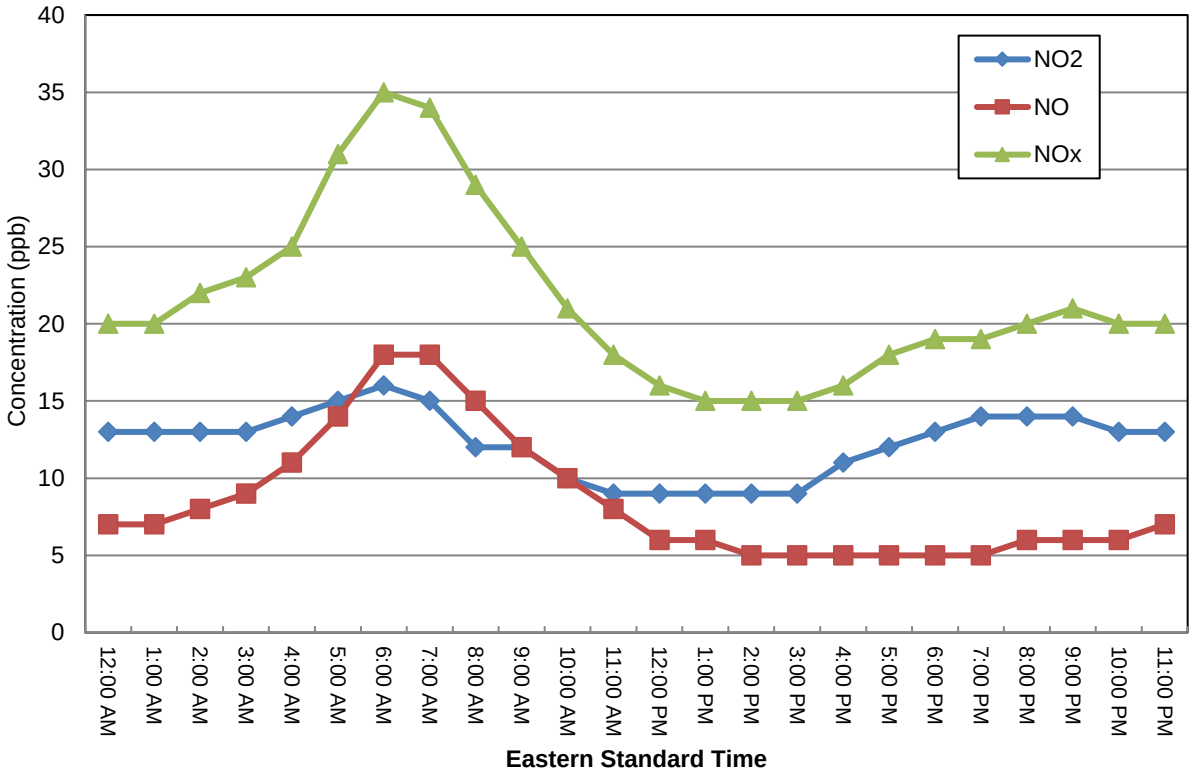
Figure 6-2 shows that NO_x concentrations tend to be higher in the winter than in the summer. This is due in part to heating of buildings, and to weather conditions that are more prevalent in the colder months of the year, such as lighter winds that result in poorer local dispersion conditions.

Figure 6-2
2018 Nitrogen Oxides Concentrations in New Jersey
Average Monthly Variation
Parts per Billion (ppb)



Because much of the NO_x in the air is emitted by motor vehicles, concentrations tend to peak during the morning and afternoon rush hours. This is shown in Figure 6-3.

Figure 6-3
2018 Nitrogen Oxides Concentrations in New Jersey
1-Hour Average Hourly Variation
Parts per Billion (ppb)



Health and Environmental Effects

Short-term exposures to low levels of nitrogen dioxide may aggravate pre-existing respiratory illnesses and cause respiratory illnesses in children, people with asthma, and the elderly. Symptoms of low-level exposure to NO and NO_2 include irritation to eyes, nose, throat and lungs, coughing, shortness of breath, tiredness and nausea. Long-term exposures to NO_2 may increase susceptibility to respiratory infection and may cause permanent damage to the lung. Studies show a connection between breathing elevated short-term NO_2 concentrations and increases in hospital emergency room visits and hospital admissions for respiratory issues, especially asthma. Individuals who spend time on or near major roadways can experience elevated short-term NO_2 exposures.

Nitrogen oxides contribute to a wide range of environmental problems. Chemical reactions in the air form both ozone and particulate matter. Nitrate particles make the air hazy and impair visibility, and contribute to nutrient pollution in coastal waters, resulting in eutrophication. NO_2 also reacts with water and oxygen to form nitric acid, a component of acid rain, which causes acidification of freshwater bodies and harms sensitive ecosystems such as lakes and forests

Ambient Air Quality Standards

There are two types of National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (USEPA), primary and secondary. Primary standards protect public health, including sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. A 1-hour primary standard for NO_2 of 100 parts per billion (ppb) was promulgated in 2010. The primary and secondary annual NAAQS for NO_2 are the same, a calendar year average concentration of 53 ppb. The annual New Jersey Ambient Air Quality Standards (NJAAQS) are identical to the NAAQS, except that micrograms per cubic meter ($\mu g/m^3$) are the standard units and the averaging time is any 12-month period (a running average) instead of a calendar year. Table 6-1 presents a summary of the NO_2 standards.

Table 6-1
National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Parts per Billion (ppb)
Parts per Million (ppm)
Micrograms per Cubic Meter ($\mu g/m^3$)

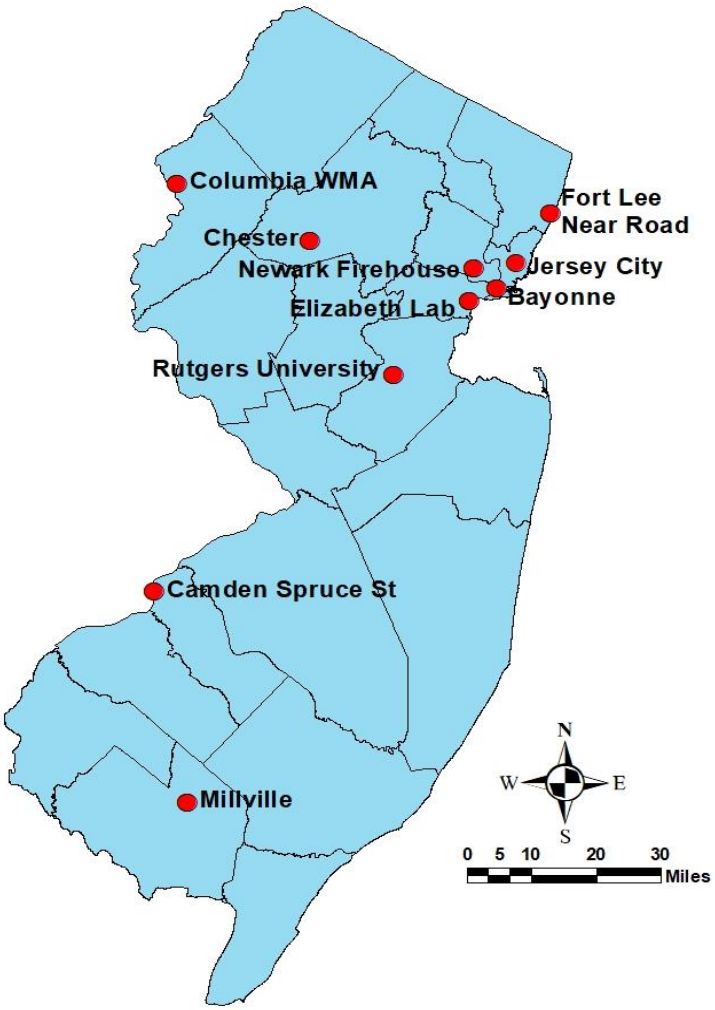
Averaging Period	Type	National	New Jersey
1-Hour	Primary	100 ppb (0.100 ppm)	---
Annual	Primary & secondary	53 ppb (0.053 ppm)	---
12-Month	Primary & secondary	---	100 $\mu g/m^3$ (0.053 ppm)

A state or other designated area is in compliance with a NAAQS when it meets the design value. For the annual standard, the annual average is the design value. However, for the 1-hour NO_2 standard, the NAAQS is met when the 3-year average of the 98th-percentile of the daily maximum 1-hour NO_2 concentrations is less than 100 ppb. This statistic is calculated by first obtaining the maximum 1-hour average NO_2 concentrations for each day at each monitor. Then the 98th-percentile value of the daily maximum NO_2 concentrations must be determined for the current year, and for each of the previous two years. Finally, the average of these three annual 98th-percentile values is the design value.

NO_2 Monitoring Network

NJDEP measured NO_2 levels at ten locations in 2018. The monitoring stations are Bayonne, Camden Spruce Street, Chester, Columbia, Elizabeth Lab, Fort Lee Near Road, Jersey City, Millville, Newark Firehouse, and Rutgers University. These sites are shown in Figure 6-4.

Figure 6-4
2018 Nitrogen Dioxide Monitoring Network



NO_2 Levels In 2018

There was one exceedance of a NO_2 NAAQS in 2018. The Fort Lee Near Road monitoring station had a daily maximum 1-hour concentration of 131 ppb on January 3 (see Table 6-2 and Figure 6-5). This is much higher than the next-highest 1-hour value (85 ppb at Jersey City), and is attributed to vehicles idling near the site.

The 98th-percentile values for each monitoring station are also shown in Table 6-2 and Figure 6-5. The design value for NO_2, which determines whether or not there is a violation of the NAAQS, is actually the 3-year average of the 98th-percentile of the 1-hour daily maximum concentrations. The 2016-2018 design value for each site is given in Table 6-2 and Figure 6-6. The site with the highest design value for 2016-2018 was Fort Lee Near Road, with 63 ppb. The design value for Millville station had incomplete data for the three-year period (see Table 6-2 footnote).

Table 6-2
2018 Nitrogen Dioxide Concentrations in New Jersey
1-Hour Averages
Parts per Billion (ppb)

Monitoring Site	1-Hour Average (ppb)		
	Daily Maximum	98th-Percentile	2016-2018 98th-%ile 3-Yr Avg
Bayonne	84	56	57
Camden Spruce St.	54	45	48
Chester	47	31	32
Columbia	45	41	44
Elizabeth Trailer	84	61	60
Fort Lee Near Road	131	68	63
Jersey City	85	58	54
Millville*	38	32	33*
Newark Firehouse	77	52	55
Rutgers University	50	42	41

*Millville was temporarily shut down February through June in 2016. Since it does not have three complete years of data for 2016 to 2018, it does not meet the design value criteria for NO_2.

Figure 6-5
2018 Nitrogen Dioxide Concentrations in New Jersey
Daily Maximum 1-Hour Values
Parts per Billion (ppb)

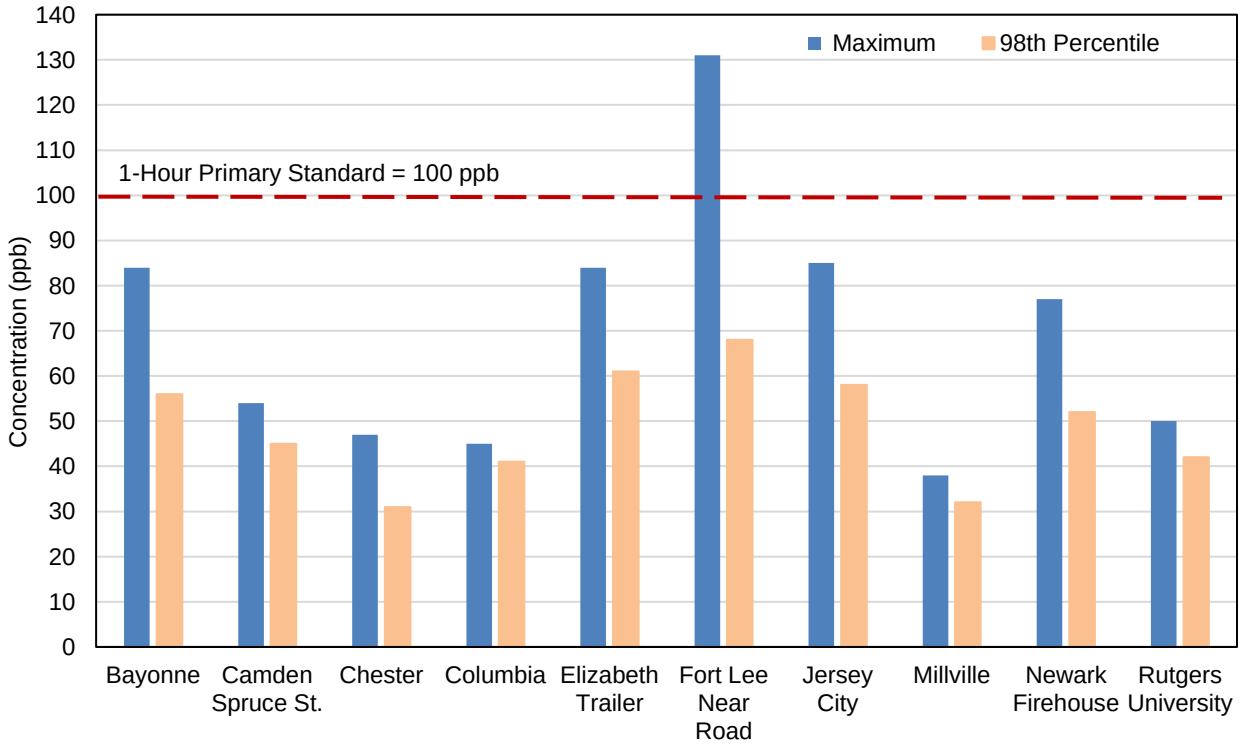
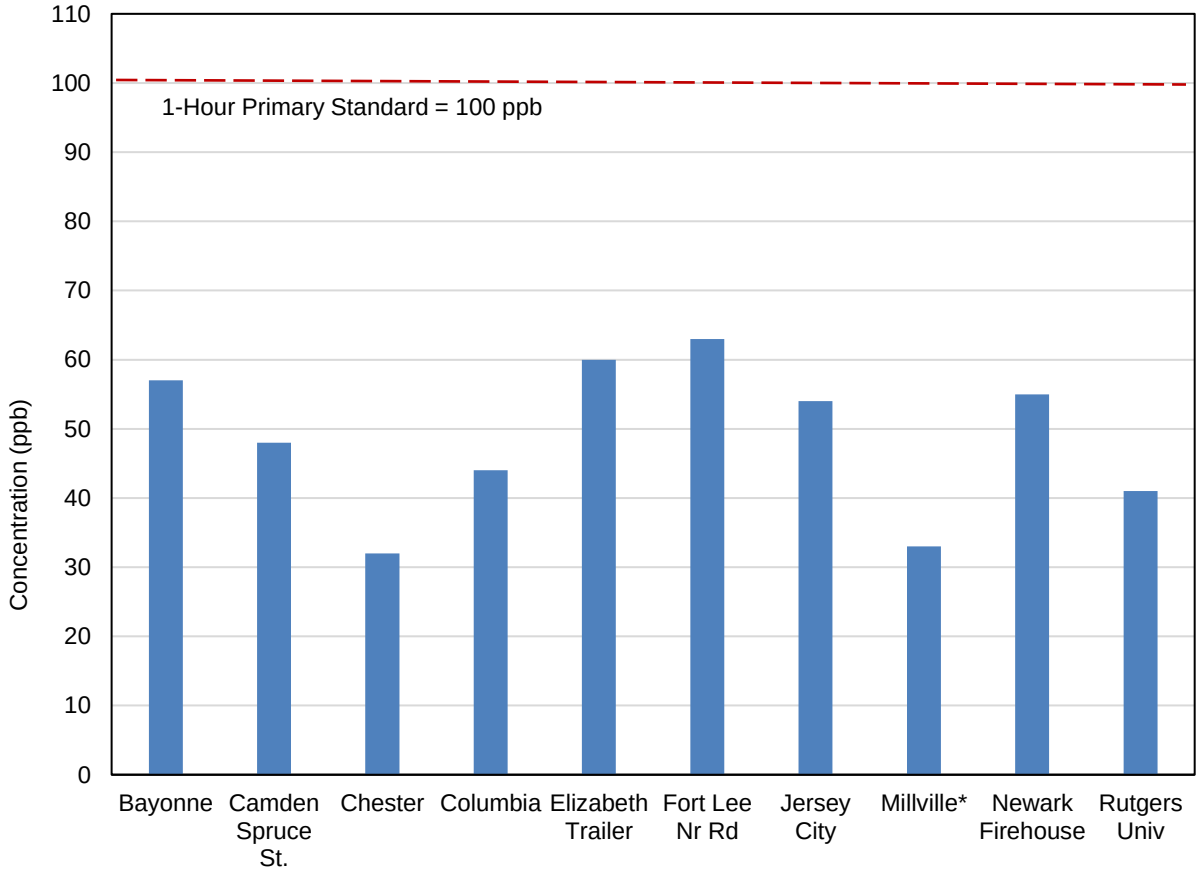


Figure 6-6
2018 Nitrogen Dioxide Design Values in New Jersey
3-Year Average of the 98th-Percentile Daily Maximum 1-Hour Concentrations (2016-2018)
Parts per Billion (ppb)



***Note:** 2016-2018 data for Millville is incomplete and does not meet design value requirements. See Table 6-2 for details.

In order to meet the annual NAAQS for NO_2, the calendar-year average (January 1 to December 31) must be less than or equal to 53 ppb, rounded to no more than one decimal place. The NJAAQS is also 53 ppb, but it is compared to the maximum running 12-month average (of any twelve consecutive months in the year). As shown in Table 6-3 and Figure 6-7, the highest calendar-year average of 19 ppb occurred at two sites, the Jersey City monitoring station on J.F.Kennedy Boulevard near Journal Square, and the Elizabeth Lab monitoring station at Exit 13 of the New Jersey Turnpike. The highest running 12-month average NO_2 concentration of 22 ppb was measured at the Jersey City site. These values are well below the standards.

Table 6-3
2018 Nitrogen Dioxide Concentrations in New Jersey
Annual (12-Month) Averages
Parts per Billion (ppb)

Monitoring Site	12-Month Average (ppb)	
	Calendar Year	Maximum Running
Bayonne	16	16
Camden Spruce Street	11	12
Chester	3	3
Columbia	9	10
Elizabeth Lab	19	20
Fort Lee Near Road	17	18
Jersey City	19	22
Millville	5	6
Newark Firehouse	14	15
Rutgers University	8	8

Figure 6-7
2018 Nitrogen Dioxide Design Values in New Jersey
Annual (12-Month) Average Concentrations
Parts per Billion (ppb)

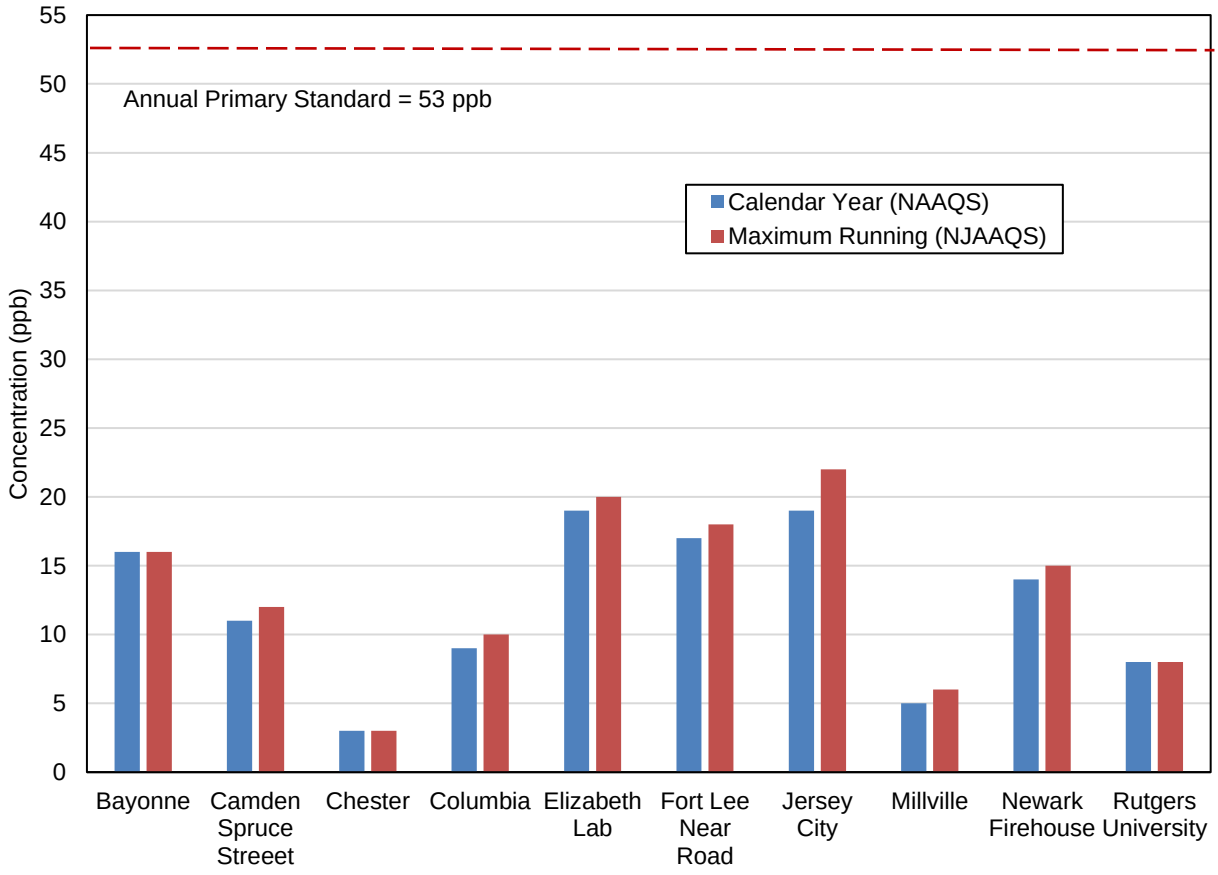
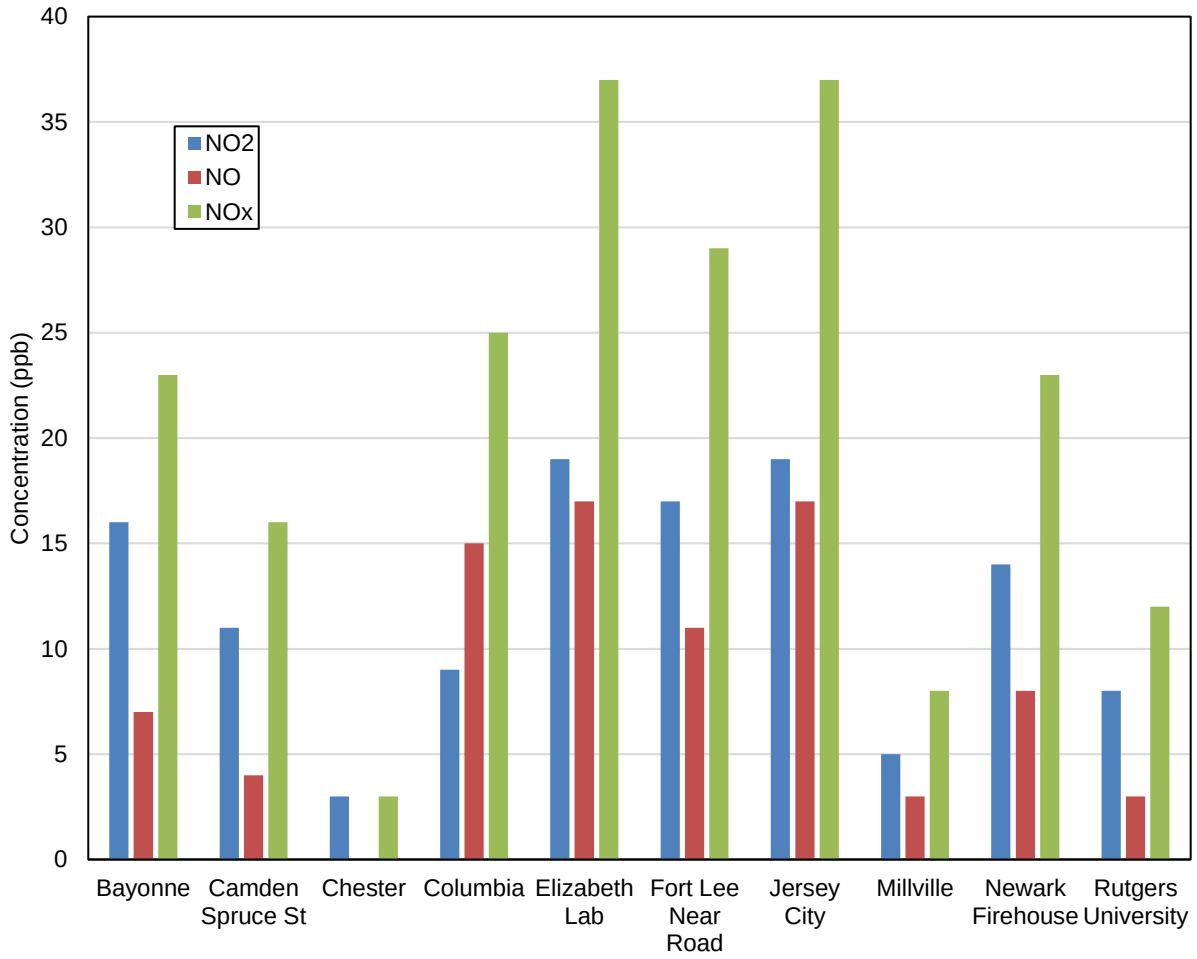


Figure 6-8 shows the calendar-year annual average concentrations of NO_2, NO and NO_x at each New Jersey monitoring site. The stations that measure NO_2 concentrations also measure NO and NO_x, even though there are no ambient air standards for them. NO_x levels are approximately (not exactly) the sum of the NO_2 and NO concentrations. The concentration of NO tends to be lower than NO_2, because it quickly reacts with other air pollutants (particularly ozone) after it is emitted from a source, and converts to NO_2. The Columbia monitoring site is an exception to this, with annual average levels of NO higher than NO_2. The monitor is about 100 feet from Interstate Highway 80. The road is a significant source of NO emissions from vehicles, but the expected conversion of NO to NO_2 is probably hindered by the area's relatively low levels of other pollutants.

Figure 6-8
2018 Nitrogen Oxides Concentrations in New Jersey
Calendar-Year Annual Averages
Parts per Billion (ppb)



Note: The annual average concentration of NO at Chester was 0 ppb.

NO_2 Trends

Routine monitoring for NO_2 in New Jersey began in 1966. The last year in which the annual average NO_2 concentration exceeded the NAAQS was 1974. The graph of NO_2 levels in Figure 6-9 shows the highest statewide annual average concentrations recorded from 1990 to 2018. Although NO_2 concentrations are well within the NAAQS, there is still a great deal of concern about the role of nitrogen oxides in the formation of other pollutants, most notably ozone and fine particles. Both of these pollutants still occasionally reach problematic levels in the northeastern United States. Efforts to reduce levels of ozone and fine particles are likely to require continued reductions in NO_x emissions.

Figure 6-10 shows the statewide highest 98th-percentile values of the daily maximum one-hour concentrations of NO_2 for the years 2000 to 2018 in New Jersey. Even though in 2018 the highest 1-hour New Jersey value exceeded the NAAQS of 100 ppb (at Fort Lee Near Road), the 98th-percentile value was below that at 68 ppb.

Figure 6-11 shows the New Jersey design values for the 1-hour NAAQS for the years 2000-2018. The design value, which officially determines compliance with the 1-hour NO_2 NAAQS, is the highest 3-year average of the 98th-percentile values of the daily maximum one-hour concentrations at each New Jersey monitoring site. New Jersey has not violated the 1-hour NAAQS since it was implemented in 2010.

Figure 6-9
Nitrogen Dioxide Concentrations in New Jersey, 1990-2018
Highest Annual (Calendar Year) Averages
Parts per billion (ppb)

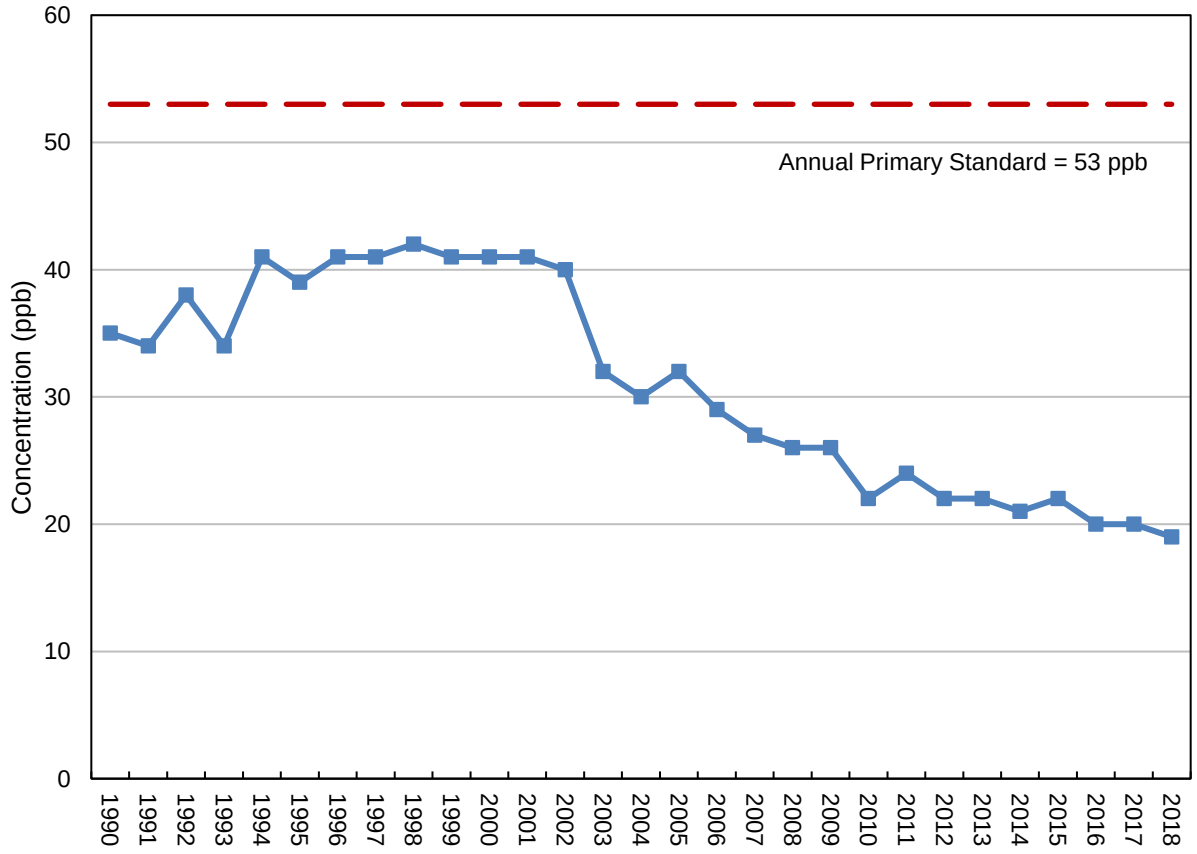


Figure 6-10
Nitrogen Dioxide Concentrations in New Jersey, 2000-2018
98th-Percentile of the Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)

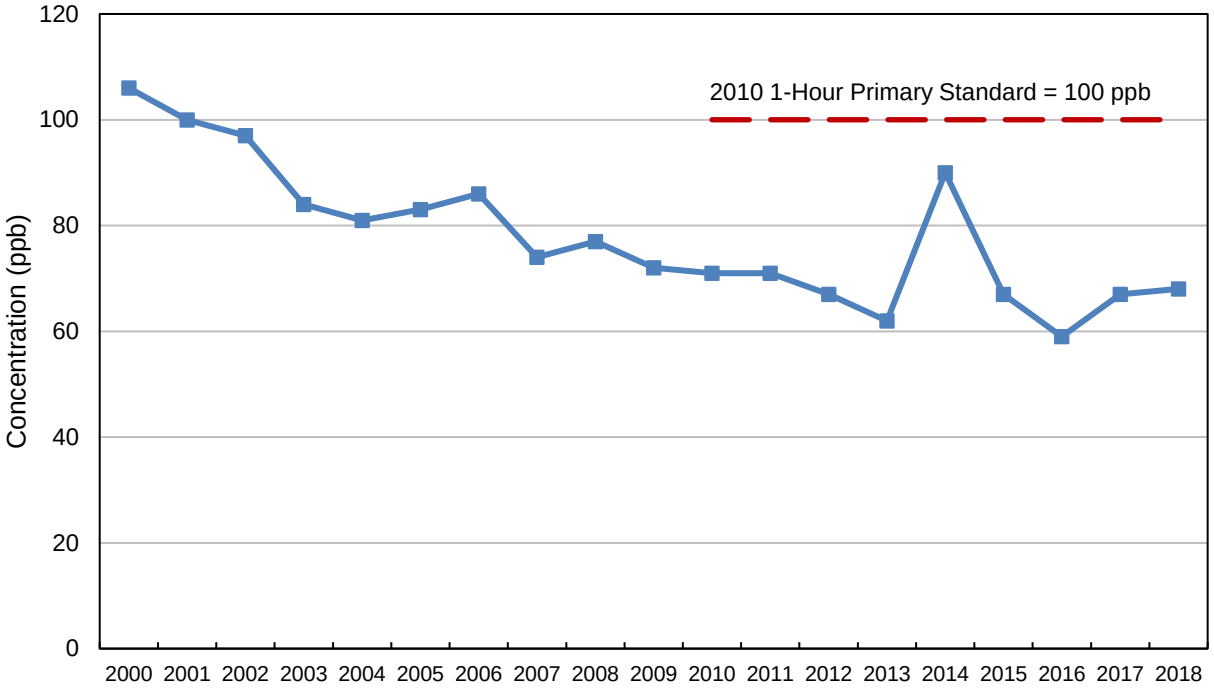
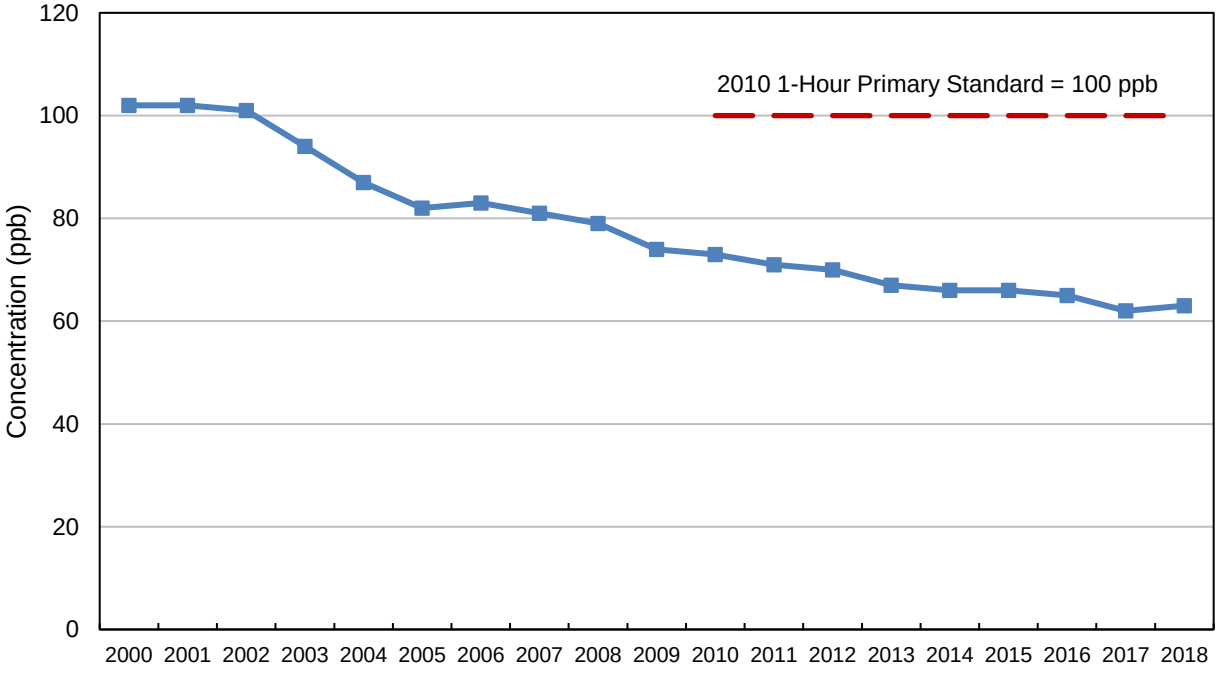


Figure 6-11
Nitrogen Dioxide Design Value Trend in New Jersey, 2000-2018
3-Year Average of the 98th-Percentile Daily Maximum 1-Hour Concentrations
Parts per Billion (ppb)



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